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the other light was 6 meters or less; if the nearer light was 10 meters distant or more, the wrong answers predominated; the threshold value was about 7–8 meters, or a difference of 17–18 meters. Another set of experiments was tried in which the subject was asked to estimate binocularly the absolute distance of a single light. The results showed no approximation to the truth, the estimates for 50 meters being in several cases nearly the same as those for 5 meters. According to the author, the muscle sensations—in this case of convergence—play no appreciable part here; it is only the bi-retinal assimilation of corresponding points that determines our sensation of depth. Thus our perception of depth, in so far as it is a sensation at all, and not a judgment, is really a visual function, and not a muscular one, as the commonly accepted theories incline to believe. The results seem to show that the visual *sensation* horizon is about 220 meters from the eye. The spherical shape of the heavens is due to the practical parallelism of all objects further than that distance, as determined by the minuteness of bi-retinal localization, rather than to the absence of changes of accommodation and convergence for greater distances.—H. C. W.

ANTHROPOLOGY.[1]

On Fossil Bird-Bones Obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee.—On the 20th of last June (1896) the writer received from Professor E. D. Cope a small collection of subfossil bones obtained by Mr. H. C. Mercer while in charge of explorations for the University of Pennsylvania in the Bone Caves of Tennessee. These bones were kindly sent to me for the purpose of having them identified if possible, and eventually described and figured. As in the case of many cave bones, they are not encased in any matrix, being to some degree pliable rather than brittle and completely fossilized. They have a rather pale clayey color, and not more than one in a dozen of them are perfect. Indeed, it is unfortunate that so many of them are in too fragmentary condition to be identified with any degree of certainty, and in the case of a few mammal bones I found in the collection no attempt was made at identification at all. Skulls and sterna are entirely absent from this collection, nearly all the specimens being long bones, with the exception of the sacral portion of one pelvis; a few coracoids and portions of unidentifiable scapulæ, and some odd vertebræ. Under these circumstances one is obliged to be extremely cautious and careful (especially in the case of birds) in coming to an opinion as to what species the bones belonged, and whether these species are still represented in existing avian faunæ or are now to be reckoned among the extinct forms. An example of this is well exemplified in the case of a small *humerus* from the right pectoral limb of a bird in this collection. It is evidently passerine, and may have belonged to any average finch or sparrow the size of a *Carpodacus*, the bone being 2 cms. long and having all the characters seen in the humeri of that size and in that group. It is practically impossible to identify such a specimen, especially in the absence of all of the rest of the skeleton, and the fact moreover, that it possibly belonged to some extinct finch, sparrow, or other small passerine type. For these reasons too, I pass by quite a number of fragments of avian ulnæ that belonged to various species, as well as other bones of the skeleton, naming only those that can be pronounced upon with certainty.

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

PYGOPODES.

Colymbus auritus.—Represented in the collection by a perfect left femur of an adult individual, as well as by the shaft of a left humerus, and the distal end of a tibio-tarsus. These bones correspond exactly with those found in examples of this Grebe now existing. I have compared them with the skeleton of one of the species in the collections of the United States National Museum (No. 17,873).

ANSERES.

A right coracoid; a right humerus; and the proximal moiety of a right ulna (all from adult birds) appear to have belonged to some species of anserine fowl. Doubt may rest with the humerus and ulna, because they are somewhat fragmentary; but the coracoid belonged to a duck or else a Merganser; it is about the size for *Aix sponsa.* Thus far I have not identified it.

GALLINÆ.

Colinus virginianus.—That the remains of the Common Virginia Partridge occurred in these caves rests upon the discovery of the right humerus of an adult individual of this species. It is found to agree exactly with the corresponding bone in specimens of this bird now existing. There is also in the collection a left humerus of a Partridge, that might easily have belonged to either a female of this species or else to a subadult individual, or finally, to perhaps a different species. It has all the characters however, of a colinine humerus, but is smaller than the one just referred to above, and in the absence of other material I believe it to be wiser not to pronounce upon it definitely at present.

Bonasa umbellus.—Numerous bones of the Ruffed Grouse were discovered in these caves. I find in the collection a left humerus and a coracoid from the same side; two ulnæ, four carpo-metacarpi (one perfect, the others nearly so), and three tarso-metatarsi with the lower half of another. These bones have each and all been carefully compared by me with several skeletons of *Bonasa umbellus* in my private collections, and I find that they agree in all their characters with the corresponding elements of the skeleton as now found in specimens of this Grouse of the existing avifauna.

The collection contains the right carpo-metacarpus of still another Grouse, the specimen being nearly perfect. It is but a millimetre or two shorter than that bone as it occurs in adult male individuals of *Tympanuchus americanus*, being at the same time almost identical in character, in fact presenting only such very slight differences as might be due to individual variation. This bone may have easily belonged to some form of this genus abundantly represented in the existing avifauna, and in the absence of the balance of the skeleton, I am by no means sure it did not. Possibly the former owner of it may have been a female *T. americanus*, or a subadult specimen, or a male *T. pallidicinctus* and so on; while in any event, without more material for comparison, it is hardly possible to say with certainty as to what the species was, more than it was a Prairie Hen (*Tympanuchus*).

Even still more puzzling is the presence in this collection of the tarso-metatarsus of a Grouse—a perfect bone from the right limb. It does not belong to any of the species I described from the Equus Beds of Oregon, and it is too small, and at the same time, *too stout* for any existing species of *Tympanuchus;* too big for a *Pediocœtes;* and too small for a female *Centrocereus*, yet there is no question but what it is the typical tarso-metatarsus of a true Grouse. I do not believe it belongs to the same species as the one to which the above described carpo-metacarpus belonged, for the bone is not big enough for that quite, and yet is just possible that it might have done so. It is far better to wait for additional and fuller material to come to light from the locality where this bone was collected, before either declaring it to be a new species or not having belonged to one now abundantly represented in our existing fauna.

Meleagrinæ: Meleagris gallopavo.—The presence of the remains of the common Wild Turkey in this collection is well attested to by the following list of bones:—

Sixth cervical vertebra and the fragments of two others.
Superior extremities of seven coracoids.
Proximal two-thirds of left humerus.
Distal end of right humerus.
Fragments of the proximal ends of two other humeri.
Proximal end of left ulna.
Fragments of four carpo-metacarpi (one largely complete).
Fragment of distal end of right femur.
Distal extremities of two tibio-tarsi (♂ and ♀ ?).
Superior portions of six tarso-metatarsi and one distal end.
Three tarso-metatarsi (fragmentary), with calcars developed thereupon.

Upon comparing these bones and fragments of bones with the corresponding ones in the skeletons of *M. gallopavo*, it leaves no doubt as to their identity. And, as in this last species, very considerable difference in size is seen to exist between the sexes, as well as between the male and females when compared with the subadult individuals. Professor Marsh at different times has described three species of alleged extinct Turkeys, viz., *Meleagris antiquus*,[1] *M. altus*[2] and *M. celer*,[3] but I am very sceptical indeed in regard to the validity of the first named, *i. e.*, *Meleagris antiquus*, or in other words, I doubt the propriety of basing a new species of fossil Turkey upon "the distal end of a right humerus," as Professor Marsh has done in this case. Nor do the characters he describes for this species, as being diagnostic, hold true. It is a positive detriment to science, in my estimation, to create new species of fossil birds upon the distal ends of long bones, and surely no assistance whatever to those who honestly endeavor to gain some idea of the avian species that really existed during prehistoric times. So far as *M. altus* and *M. celei* are concerned, I can only say that I know nothing of them from a personal examination of the material upon which the species are based, and this has been refused me.

In the case of *Meleagris altus* Professor Marsh says that the length of the tarso-metatarsal is equal to 176.5 mm. (p. 261) and the present writer says that it is by no means uncommon to find the same bones in adult male specimens of *M. gallopavo* fully of that length, if not longer.

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[1] Am. Jour. Sci., II, 1871, 126.

[2] Pr. Acad. Nat. Sci. Phila., 1870, 11; and Am. Jour. Sci., IV, 1872, 260.

[3] Am. Jour. Sci., 1872, 261.

The other characters Professor Marsh enumerates may each and all be due to sexual and individual variations.

In the case of *Meleagris celer* this likewise holds true, and in regard to the statement that the " remains preserved indicate a bird about half bulk of *M. altus*," may be said with equal truth of *M. gallopavo*, in which species a similar discrepancy in size also exists between the sexes and between old and young.

In other words I am of the opinion, so far as I am able to judge from his descriptions, than when Professor Marsh described his three extinct and new species of *Meleagris*, he had nothing more or less before him than the very meagre and fragmentary remains of *M. gallopavo*.[4]

Columbidæ: Ectopistes migratorius.—The Passenger Pigeon is represented in the collection by subfossil bones from several adult individuals, viz.:—

Two left humeri (nearly perfect).
Four fragments of humeri.
One left carpo-metacarpi (perfect).
Three carpo-metacarpi (imperfect).
Several coracoids (worn, and so doubtful).
One pelvic sacrum.
One left femur (perfect).

The several bones differ in no way with the corresponding bones as they occur in adult specimens of *Ectopistes* as they exist at the present times.

STRIGES.

Megascops asio.—The Screech Owl is represented by a single specimen of a tarso-metatarsus—the bone agreeing completely with the corresponding one in the pelvic limb (of this species) of a skeleton in the private collection of the writer.

PICI.

Ceophlœus pileatus.—A right *ulna* with the extremities of the bone imperfect represents the Pileated Woodpecker in the collection. The specimen agrees exactly with the ulna of this species in the pectoral limb of a skeleton in my own cabinets. Even the prominent papillæ of the quill-butts of the secondary feathers down the shaft (and so characteristic of the ulnæ of true Pici), agree in number and in their several and corresponding distances apart, in the two bones when compared.

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[4] The relation of the specimens to the human culture layers discovered, the associated remains of the Tapir, Mylodon and other mammals identified by Professor Cope, and the shells identified by Professor Pilsbry is to be fully discussed later in the forthcoming reports of the Tennessee Expeditions of the University.

Thus it will be seen that the subfossil bones of birds in this collection from the several Bone Caves of Tennessee (so far as I have been able to identify them with certainty), belonged only to species still abundantly found in our avifauna, or were found there. Of the species enumerated below, it may be said that the Wild Turkey and the Passenger Pigeon are on the high road toward total extinction.

Colymbus auritus.
Bonasa umbellus.
Ectopistes migratorius.
Ceophlœus pileatus.
Colinus virginianus.
Meleagris gallopava.
Megascops asio.

To these may be added a doubtful Duck aud a Grouse, while still other bones represent species that cannot be satisfactorily identified until the skeletons are made more complete by the discovery of additional material.—R. W. SHUFELDT.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Torrey Botanical Club.—Wednesday evening, March 31, 1897. —The first paper, by Dr. Albert Schneider, "The Phenomena of Symbiosis," and a paper by Leonard Barron on "Horticulture in Botanical Gardens," were read by title.

The evening was occupied by a paper by Prof. Edward S. Burgess on "Aster macrophyllus and its Allies," illustrated by chart of relationship and by numerous specimens. The speaker sketched briefly the history of the species *Aster macrophyllus*, in which it has been the custom of American botanists to include all large leaved Asters. He showed how diverse these Asters are, and in what confusion their assignment to a single species results, and indicated the characters according to which they form two groups each of several species and varieties.

The paper which will soon appear in print, was discussed by Mr. E. P. Bicknell, who confirmed the distinctions offered by the results of his observations about New York, and by Dr. Britton, who paid a tribute to the masterly manner in which Dr. Gray had treated the subject of the genus Aster so far as material was then available, and who referred to the special need for extended field work and further collaboration which this genus had long presented.